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Short term outcome after emergency and elective surgery for colon cancer

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Abstract:

Objective: Emergency presentation of colon cancer is common, and it is associated with high mortality and morbidity following initial surgical treatment. The purpose of this study was to evaluate postoperative mortality and complications in a consecutive and population based series.

Methods: All patients with adenocarcinoma of the colon diagnosed between 1993 and 2007 were registered prospectively. Mortality and complication rates for elective and emergency patients were compared. Logistic regression analysis was used to identify independent risk factors for postoperative complications.

Results: In the study period 1129 patients were admitted, 237 (21 %) of whom presented as an emergency. A total of 1001 (89%) patients underwent surgical treatment; 926 patients (82%) had a major resection, and the mortality rate was 3.5 % after elective and 10 % after emergency operation ($p<0.01$). The complication rate was 24 % and 38 % ($p< 0.01$), respectively. In patients with left sided obstruction, the mortality rate after Hartmann's procedure was 19 % as compared to 3 % after resection with primary anastomosis ($p< 0.01$). Following surgery without tumour resection, the mortality was 17 % and 24 % after elective and emergency operation, respectively. Multivariate analyses demonstrated that emergency operation, increasing age, advanced tumour stage and ASA class IV were independent risk factors for postoperative mortality.

Conclusions: Emergency operation for colon cancer was associated with high mortality and complication rates also in this series, indicating that immediate surgery should be avoided if possible. Resection with primary anastomosis is probably preferable to Hartmann's procedure in left sided colon obstruction if non-operative treatment by endoluminal stenting fails.

Introduction:

Colorectal cancer is the second most common cause of cancer in Western Europe, and Norway has one of the highest incidences in Europe. About 10-30 % of the patients present with acute symptoms, usually due to bowel obstruction. Emergency presentation is associated with an increased postoperative morbidity and mortality rate, as well as poor 5 year survival [1-5]. The treatment options are changing with time, and some improvement of the results has been demonstrated [6]. In recent years the results after placement of self-expanding endoluminal stents to decompress an obstructed colon, as bridge to surgery within 1-2 weeks, has been promising.

Since 1993 all new cases of colon cancer admitted to Aker University Hospital from a defined city population, have been registered prospectively. The purpose of the present study was to investigate this cohort of patients for complications and mortality, and to compare the outcome after elective and emergency operation. In addition, we wanted to identify subgroups of high risk for developing complications after surgery, with a focus on the emergency patients who seem to be in need of new treatment options to avoid the emergency operation.

PATIENTS AND METHODS

All patients admitted to Aker University Hospital in Oslo with adenocarcinoma of the colon or the rectosigmoid flexure (> 15 cm above the anal verge) in the period 1993 - 2007 were included. The hospital has a defined catchment area with approximately 210 000 inhabitants. In Norway the departments of pathology report all cases of cancer to the Cancer Registry of Norway, and checking against this database ensured the identification of all new patients diagnosed with colon cancer during the period. Data regarding elective or emergency presentation, preoperative examinations, operative treatment, histopathological findings and per- and postoperative complications were registered prospectively by the surgeon responsible for discharging the patient from the hospital. For patients admitted as emergencies additional data regarding the cause of admittance and more details on the initial treatment, were collected retrospectively from the patient records.

All patients who presented with acute symptoms and who were hospitalised without scheduled investigation or treatment were defined as having emergency presentation, and if they underwent surgery without standard preoperative preparation defined as having emergency operation. Resection of the tumour-bearing segment of the colon was classified as a major resection. Post-operative mortality was defined as death during hospital stay. Tumour stage was classified according to the UICC tumour, node and metastasis categories. The cancer was defined as right-sided if located from coecum to the left part of the transverse colon, and left-sided if located in the descending colon or more distally, excluding those patients having a tumour in the left flexure or who had more than one tumour. Left flexure tumours were analysed separately as they are sometimes treated as a left-sided tumours, sometimes as right-sided tumours.

All data were registered on special forms and then stored in a database, Microsoft Access version 2.0 (Microsoft Corporation, Redmond, Washington, USA). All statistical analyses were performed with SPSS 14.0 (Statistical Product and Service Solutions, Chicago, Illinois, USA). Most sets of

continuous data were of non-normal distribution, and measures of location (variation) were given as median (range). Differences between proportions were analyzed with Pearson chi-square test or Mann- Whitney U-test as appropriate. Logistic regression was used for multivariate analyses of possible prognostic factors identified by univariate analyses. Significance was claimed when the p-value of a two-sided test was less than or equal to 0.05.

The study was performed according to the Helsinki declaration, and approved by the Regional Ethical Research Committee.

RESULTS

A total of 1129 patients were admitted in the study period, 237 (21 %) of whom presented as emergencies (Figure 1) with a symptom duration of median three (1-14) days. Eighty per cent of the emergency patients presented with obstruction (Table 1) and 13 % with perforation. The remaining patients were operated for suspected acute appendicitis, incarcerated hernia or gynecological conditions.

One thousand and one (89 %) patients were operated, and the patient characteristics and surgical procedures are summarized in Table 2, showing that 926 patients (82 % of all admitted) underwent major resection and 75 (7 %) operation without resection. Median age of patients who had emergency operation was 76 (33-96) years, compared to 74 (24-93) years for those who underwent elective operation ($p= 0.05$). Patients who underwent emergency operation had more advanced tumour stage ($p< 0.01$), the proportion of right sided tumours were slightly higher (59 % versus 54 %, $p= 0.18$, left flexure tumours excluded), and they more often underwent resection without anastomosis ($p< 0.01$), and more often had a proximal diversion or bypass procedure ($p< 0.01$).

Mortality and complications in elective and emergency patients are compared in Table 3. Following major resection patients who had emergency operation had higher mortality rate and more complications than patients who were operated electively. Patients who underwent operation without resection had higher mortality rate than patients who were resected, and the mortality rate was reaching 24 % and 17 % for emergency and elective operation, respectively ($p=0.32$).

The mortality and complications rates in 148 patients who presented with colonic obstruction without perforation are presented in Table 4. In patients with left sided obstruction, the mortality

rate was 19 % following Hartmann's procedure and 3 % following segmental resection with primary anastomosis ($p< 0.01$), although age and ASA-score (American Society of Anesthesiology) were similar in the two patient groups (data not shown). The mortality rate was 9 % in patients with right sided obstruction treated with resection and primary anastomosis.

Twenty-seven of the patients who underwent emergency operation presented with perforation (Table 1). ? The perforation resulted in pericolic abscess formation in nine patients (27 %), and in diffuse peritonitis in 20, of whom 12 had feces in the abdominal cavity. The mortality and complication rates in patients who had perforation were similar to patients who had obstruction (data not shown).

In the last years of the study period, the method of endoluminal stenting has been introduced in the department. The placement of a stent was attempted in 10 patients and was technically and functionally successful in seven of these patients.

Multivariate analyses demonstrated that emergency operation, increasing age and advanced tumour stage was associated with increased mortality rates (Table 5). Emergency operation, increasing age and male sex were associated with increased complication rates. The ASA score was available in patients who underwent emergency operation; there were no difference in mortality rates between ASA II (7 %) and ASA III (9 %) patients, whereas patients with ASA IV had a mortality rate of 41 % ($p < 0.001$) .

DISCUSSION

The present study is one of the largest prospective, single centre studies presented. It is population based and the risk of selection bias should be minimal. Death data are complete, and we think that the registration of major surgical complications is complete, whereas minor complications might have been missed. In this city cohort, 21 % of patients were admitted as emergencies, and those patients were slightly older and had a more advanced tumour stage than patients admitted electively, as shown in other series [2, 4, 8]. Bowel obstruction was present in 85 % of the emergency patients, in accordance with previous publications from other areas [1, 3, 5, 6, 9].

The main finding in the present study was that patients who undergo emergency operation have significantly higher mortality and overall complication rates than patients operated electively. Post operative myocardial infarction rate was significantly raised in emergency patients, but not the rates of pulmonary complications or infection, in contrast to previous studies [2, 6, 10]. If true, the reason may be improvement in prophylactic treatment over the last decades, but incomplete registration of these complications cannot be excluded.

Following major resection the mortality rate was 10 %, as compared to 24 % after surgery without resection, similar to previously published results [5]. These figures demonstrate that patients undergoing emergency operation are at high risk, and alternative treatment options should always be kept in mind.

Patients with perforation to the peritoneal cavity must be treated by operation. However, in patients

with obstruction and no signs of perforation, there are both surgical and non-surgical treatment options. There is general agreement that right sided colon obstruction usually should be treated by resection and primary anastomosis, a policy applied in 81 % of the patients in the present series, and with a mortality rate of 9 %. A bypass procedure was done in 15 % of the patients, usually because the primary tumour was not resectable, and the mortality rate was 36 %. Endoluminal stenting is often not possible in right sided tumours, but in our view an attempt should be considered in frail patients with ascending and transverse colon tumours due to the high mortality following surgical treatment [2, 11].

There are several treatment options available in left sided colon obstruction without perforation and the optimal treatment has been under debate for several years [12, 13]. The Hartmann's procedure was previously considered the safest option, avoiding the risk of anastomotic leakage. In the present series, 25 % of the patients underwent Hartmann's procedure with a mortality rate of 19 %. Segmental resection with primary anastomosis, often combined with on-table bowel lavage, was done in 55 % of the patients and the mortality rate was 3 %. This difference in mortality rate was statistically significant, however, the patients were not randomized and probably the case-mix was different in the groups, and no firm conclusion can be drawn regarding which procedure is the safest. However, it is obvious that Hartmann's procedure is associated with high complication and mortality rates, as shown in our and other studies [9, 12, 13]. In addition, there are complications associated with stoma closure and creation of a colorectal anastomosis. Thus, the Hartmann's procedure should probably be avoided, if possible, in patients with colon obstruction.

Subtotal colectomy and diverting stoma without resection was performed in few patients, and no firm conclusion can be drawn with regard to the use of these methods of treatment. Endoluminal stenting was introduced in the hospital during the last few years of the study period, and was successfully accomplished in seven of 10 patients with left sided obstruction. There was no

mortality in this group. In accordance with recent studies [7, 14], we think that stent placement for decompression as a bridge to surgery within 1-2 weeks, should be the first treatment option in left sided obstruction.

Bypass procedures and diverting stoma operation was associated with a high mortality rate of 17 % also in the elective setting. If operation without resection is planned before laparotomy, one could rather consider stent placement as the definite treatment, although the long term efficiency in terms of palliation is not yet well documented. Subsequent surgery might be undertaken if stent placement fails or does not give satisfactory effect on the patient's symptoms.

The incidence of perforation seems to be similar toin harmony with other reports [1, 2, 6]. There were no significant differences in overall complications and mortality rates between patients who presented with obstruction and those presenting with perforation. This was unexpected, as other authors have documented increased risk of complications after perforation [2, 6]. Our results might be due to low number of patients.

In addition to the increased risk for patients with emergency presentation, multivariate analyses as expected documented an increased risk of complications and mortality with increasing age. Unexpectedly, males had more complications than females, for which the explanation is unclear. Patients with stage IV cancer had higher mortality rate than patients who did not have distant metastases, as found in other studies [4, 5, 7, 15, 16].

ASA IV patients carried a significantly raised risk of complications. This seems reasonable, and is also supported by previous studies [5, 7]. On the other hand there was no significant difference between ASA II and III patients. This might be due to low number of patients or that the ASA classification is not a linear scale.

In conclusion, the present study demonstrates that a large proportion of colon cancer patients present with acute symptoms. Emergency operation is associated with high mortality and complication rate and should be avoided if possible. Left sided colon obstruction should primarily be treated with endoluminal stenting, and even obstruction of the transverse and sometimes the right colon should be considered for stent placement. If immediate operation is necessary, resection and primary anastomosis seems justified in the majority of cases,

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Figure 1: Treatment of patients admitted in the study period.

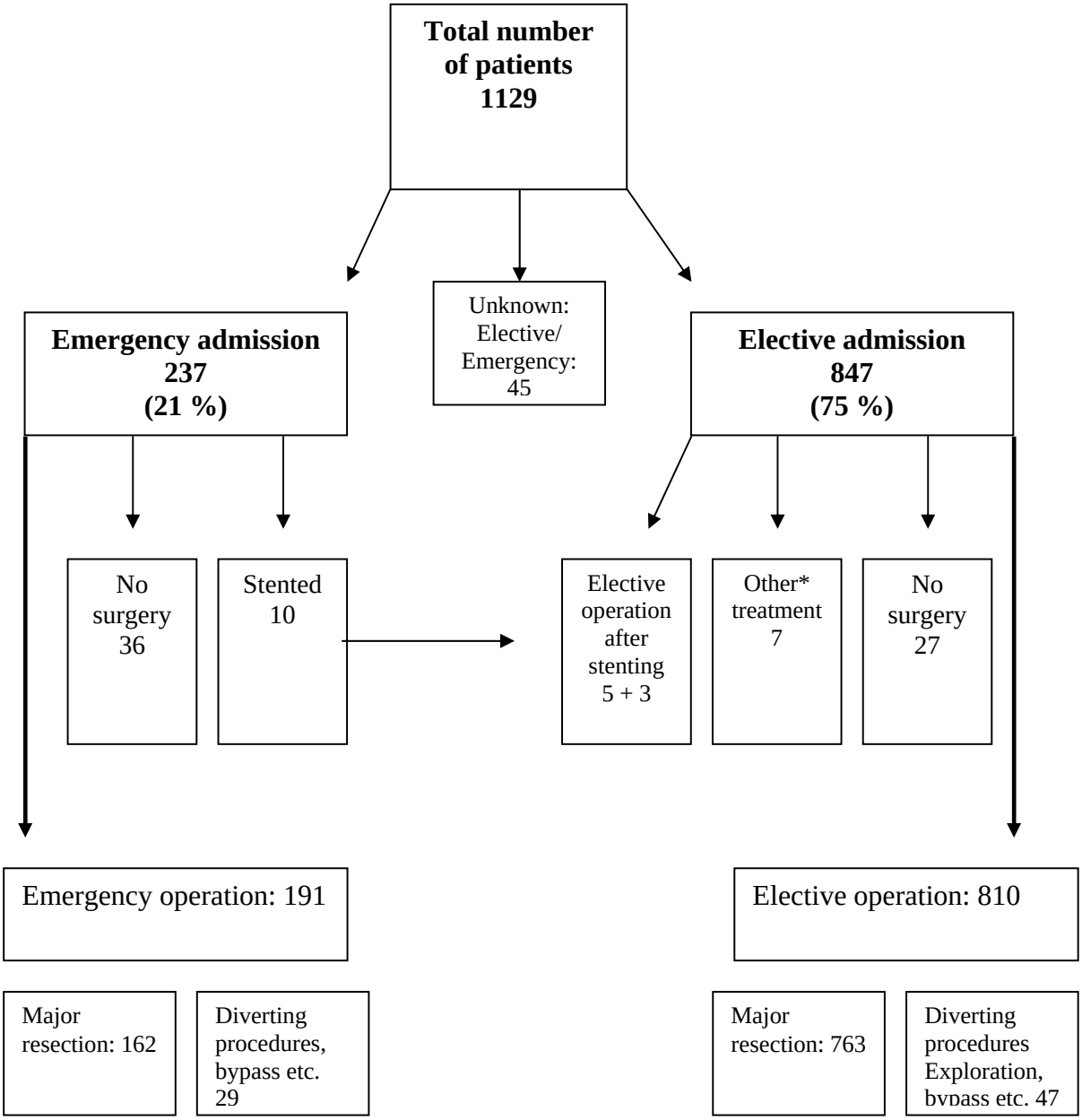

Table 1: The clinical presentation of patients who underwent emergency operation

Cause	No. of patients	Percent
Obstruction	152	80
Obstruction with proximal perforation	10	5
Perforation in tumour area	15	8
Perforation, uncertain location	2	1
Other cause	10	5
Missing	3	2

Table 2: **Characteristics of patients who underwent surgery**

	Elective surgery (n= 810)		Emergency surgery (n= 191)		
	N	(%)	N	(%)	P
Sex					
Male	371	(46)	87	(45)	
Female	439	(54)	104	(54)	
Location					
Coecum – Ascending colon	327	(40)	57	(29)	0.12
Right flexure and transverse colon	112	(14)	35	(18)	
Left flexure	38	(5)	16	(8)	
Descending and sigmoid colon	245	(30)	66	(35)	
Rectosigmoid flexure	56	(7)	11	(6)	
More than one tumour	30	(4)	3	(2)	
Unknown	2	(1)	5	(3)	
Right colon*	439	(59)	92	(54)	
Left colon*	301	(41)	79	(46)	
Dukes' Stage					
Stage I	108	(13)	3	(2)	< 0.01
Stage II	296	(36)	62	(32)	
Stage III	192	(24)	48	(25)	
Stage IV	149	(18)	64	(33)	
Unknown	65	(8)	14	(7)	
Procedure					
Major resection and anastomosis	749	92	133	70	
Major resection without anastomosis	15	2	29	15	< 0.01
Bypass procedure	28	4	15	8	
Diverting stoma	12	1.5	14	7	< 0.01
Other	6	0.5			

* Patients with left flexure tumour and more than one tumour excluded

Table 3: Complications after surgery, comparing elective and emergency operations.

	Elective		Emergency		p-value*
	n	%	n	%	
Major resection					
Mortality (in hospital)	27	(3.5)	16	(10)	<0.01
Overall complications	182	(24)	62	(38)	<0.01
Myocardial infarction	12	(1.6)	7	(4.3)	0.03
Postoperative bleeding	12	(1,6)	4	(2,5)	0.30
Infection	50	(6.6)	15	(9.3)	0.15
Abscesscsess	9	(1.2)	2	(1.2)	0.60
Leakage	18	(2.4)	5	(3.1)	0.38
Ileus	7	(0,9)	2	(1.2)	0.49
Wound dehiscence	17	(2.2)	5	(3.1)	0.34
Thrombo-embolism	7	(0,9)	2	(1.2)	0.49
Pneumonia	39	(5.1)	9	(5.6)	0.47
Sepsis	1	(0.1)	1	(0,6)	0.32
Non-resectional surgery					
Mortality (in hospital)	8	(17)	7	(24)	0.32
Overall complications	12	(25)	13	(45)	0.07
Myocardial infarction	2	(4.3)	0		0.38
Postoperative bleeding	0		0		
Infection	1	(2.1)	1	(3.4)	0.62
Abscess	0		1	(3.4)	0.38
Leakage	0		3	(10)	0.05
Ileus	0		2	(6.9)	0.14
Wound dehiscence	0		2	(6.9)	0.14
Embolism	0		1	(3.4)	0.38
Pneumonia	1	(2.1)	2	(6.9)	0.32
Sepsis	0		0		

Table 4 Operative treatment and complications in patients with obstruction but without perforation

		Mortality		Complications	
		n	%	n	%
Left-sided obstruction, n= 65	**n**				
Segmental resection and anastomosis	36	1	3	18	50
Hartmann's procedure	16	3	19	9	44
Subtotal colectomy and anastomosis	4	1	25	1	25
Diverting stoma, no resection	9	1	11	2	22
Right-sided obstruction n= 73					
Resection and anastomosis	59	5	9	17	28
Bypass procedure	11	4	36	7	64
Diverting stoma, no resection	3	1	33	2	67

Table 5. Risk factors for mortality, multivariate analyses, all in patients who underwent surgery

	Mortality			Complications		
	HR	**95 % CI**	**p**	**HR**	**95 % CI**	**p**
Emergency vs elective operation	2.5	1.4 – 4.5	0.001	2.0	1.4 – 2.8	< 0.001
Male vs female	1.5	0.87 – 2.6	0.14	1.6	1.2 – 2.1	< 0.01
Age 0-69 years	Ref			Ref		
Age 70-79 years	2.7	1.2 – 5.9	0.02	1.5	1.1- 2.1	0.03
Age $\geq$ 80 years	4.0	1.8 – 9.0	0.001	1.8	1.2 – 2.6	< 0.01
Stage I-II	Ref			Ref		
Stage III	1.4	0.64 – 2.8	0.42	1.3	0.9 – 1.8	0.28
Stage IV	2.6	1.3 – 5.2	0.006	1.1	0.7 – 1.6	0.62
Stage unknown	2.3	0.90 – 5.7	0.09	1.6	0.9 – 2.6	< 0.001